

By this response, claims 17, 25 and 27 have been amended to more specifically distinguish the claimed invention over the prior art.

The present invention pertains to a method of forming a metal product, such as a kitchen knife, having a cutting edge having a wear resistant surface. In accordance with the present invention, a knife substrate is formed having a cutting edge portion. A high-density coating process is performed to coat at least the cutting edge portion of the knife substrate with a wear resistant coating material. A hot isostatic pressing treatment is performed on the coated knife substrate to obtain a kitchen knife having a wear resistant surface comprised of the coating material. The wear resistant surface is formed at the cutting edge portion with diffusion bonding between the coating material and the knife substrate. The cutting edge portion is then sharpened, with the diffusion bonding between the coating material and the knife substrate retaining the wear resistant coating material on the cutting edge portion during the edge sharpening process.

This wear resistant coating is applied to improve the cutting ability of the sharpened knife. In the prior art, a superalloy, such as a nickel or cobalt-based superalloy, is used to provide wear resistant qualities to a steel substrate, such as a drill bit. Referring to the Drawings and the Background of the Invention of the originally filed specification (see, page 5, lines 5 – 17):

Figure 12(a) is a side view of a prior art tool bit coated with a wear resistant coating. In this case, the wear resistant coating may be applied by the Chemical Vapor Deposition method so that the entire tool bit substrate receives an even thin film of a relatively hard material, such as Carbide, Cobalt or TiN. Since the coating adheres to the tool bit substrate mostly via a mechanical bond located at a boundary interface, flaking and chipping of the coating off of the substrate is likely to occur during use, limiting the service life of the tool bit. Figure 12(b) is a side view of a prior art tool bit having a fixed wear resistant cutting tip. In this case, a relatively hard metal cutting tip is fixed to the relatively soft tool bit substrate. The metal cutting tip, which is typically comprised of a Carbide or Cobalt alloy, is fixed to the tool bit substrate by brazing. During extended use the tool bit is likely to fail at the relatively brittle brazed interface between the metal cutting tip and the tool substrate, and again, the useful service life of the tool bit is limited.

As this passage shows, it was known to apply a material that has wear resistant properties to a tool bit blank. The reasons that the entire tool bit is not made from the wear resistant material are the cost of the material and relative difficulty in forming complete objects from the wear resistant material, as well as other mechanical characteristics such as brittleness. Thus, it has been known to affix a wear resistant cutting tip by brazing or depositing a thin film of wear resistant material as a coating applied to the less expensive, easier to form metal tool blank. However, as described in this passage from the Background of the Invention, “the coating adheres to the tool bit substrate mostly via a mechanical bond located at a boundary interface, flaking and

chipping of the coating off of the substrate is likely to occur during use". Further, in the case of an affixed cutting tip, "the tool bit is likely to fail at the relatively brittle brazed interface between the metal cutting tip and the tool substrate". These problems are consistently encountered with the conventional solutions for providing a wear resistant surface to a cutting tool.

The present invention, on the other hand, specifically and effectively solves the problem of the conventional art. In accordance with the present invention, as is now clearly recited in the claims, the wear resistant surface is formed at the cutting edge portion with a diffusion bonding between the coating material and the knife substrate. The cutting edge portion is then sharpened, with the diffusion bonding between the coating material and the knife substrate retaining the wear resistant coating material on the cutting edge portion during the edge sharpening process. Thus, in accordance with the present invention, the difficulties of quickly dulled edges that have plagued user of cutting tools such as drill bits and kitchen knives can be relieved. Applicant respectfully submits that there is no mention of these drawbacks or applicant's innovative solution to solving these drawbacks in the AAPA or the cited patent references.

The passage from the original application reproduced above is the only mention in the AAPA of the problem associated with cutting tools and wear resistant surfaces. The other AAPA all have to do with turbine engine components and the failure and repair problems specifically associated with these complex engines.

The examiner cites Liburdi as disclosing a method of repairing metal articles.

This reference discloses a technique to repair or join sections of a superalloy article. A powder matching the superalloy composition is sintered in its solid state to form a porous structure in an area to be repaired or joined. A layer of matching powder, modified to incorporate melting point depressants, is added to the surface of the sintered region.

Liburdi discloses that the joint is raised to a temperature where the modified layer melts while the sintered layer and base metal remain solid. The modified material flows into the sintered layer by capillary action resulting in a dense joint with properties approaching those of the base metal. This reference discloses that HIPing can be used as part of the heat treatment to close any minor interior defects.

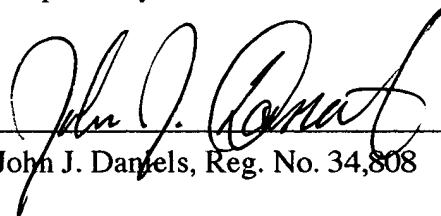
This reference does not remotely suggest that the formation of a diffusion bond between a wear resistant coating and a cutting tool substrate results in a superior cutting tool when sharpened. The AAPA related to cutting tools also do not suggest the inventive process wherein a diffusion bond between a wear resistant material and a cutting tool substrate is formed prior to sharpening the edge portion of the cutting tool. In fact, the examples of cutting tools cited in the AAPA point out the deficiencies of the conventional method of applying a mechanically bonded coating or a brazed cutting tip as the solution to the wear problems with cutting tools.

Applicant respectfully submits that the claims presented herein are patentably distinguished from the AAPA and the cited reference. Accordingly, applicant respectfully submits that the claims of the present application are allowable over the prior art. In view of the foregoing, favorable reconsideration and allowance of the claims of the application are most respectfully requested. The Examiner is invited to contact the undersigned by telephone if there are any questions or suggestions regarding the present application.

Respectfully submitted,

December 10, 2002

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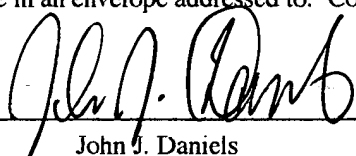


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MAILING CERTIFICATE

Date of Deposit: December 10, 2002

I hereby certify that this correspondence is being deposited with the United States Postal Service as "First Class Mail" on the date indicated above in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231.



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D1
17) A method of forming a metal product having a cutting edge having a wear resistant surface, comprising the steps of: forming a workpiece substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the workpiece substrate with a wear resistant coating material; performing a hot isostatic pressing treatment on the coated workpiece substrate to obtain a metal product having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the workpiece substrate; and sharpening the cutting edge portion so that the diffusion bonding between the coating material and the workpiece substrate retains the wear resistant coating material on the cutting edge portion during the sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product.

D2
25) A method of forming a metal product having a cutting edge according to claim 17, wherein the cutting tool comprises one of a drill bit, end mill, lathe tool bit, saw blade, planer knife, and cutting tool insert.

D3
27) A method of forming a kitchen knife having a cutting edge having a wear resistant surface, comprising the steps of: forming a knife substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the

knife substrate with a wear resistant coating material; performing a hot isostatic pressing treatment on the coated knife substrate to obtain a kitchen knife having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the knife substrate; and sharpening the cutting edge portion so that the diffusion bonding between the coating material and the knife substrate retains the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed kitchen knife.

D3
Amid